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THE OVERVIEW OF ADDITIVE MANUFACTURING

Abstract: Additive Manufacturing (AM) belongs to a class of manufacturing processes that are based on the idea of adding layers of material at each other. These processes are inherently very different from subtractive processes. Subtractive processes, such as milling, turning or drilling, use careful tool movement to remove material from the workpiece to form the desired shape of the product. And so lately you can hear how someone made jewelry for himself, a key chain, dishes, home accessory, phone case or something else using 3D printing. Despite the fact that the younger generation has grown up with information technologies, few of them understand that thanks to such technologies, not only original accessories can be printed, but also larger-scale items that belong to such industries as the automotive, aviation and aerospace industries, as well as in instrument making and medicine. On the Internet, there can hardly be found a sensible article in which a person can understand additive technologies. But to understand this area you need to read a few articles to understand the fundamentals of additive technologies. Therefore, in this article, the author will help future specialists in the initial stages of learning to sort it all out and give a base to put their knowledge on. We will tell the story of the emergence of additive technologies, how to classify production and where this technology is being used today.

Keywords: additive manufacturing, additive fabrication, 3D printing.

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ОБЗОР АДДИТИВНЫХ ТЕХНОЛОГИЙ

Аннотация: Аддитивные технологии относятся к классу производственных процессов, которые основаны на идеи добавления слоев материала друг на друга. Эти процессы по своей сути сильно отличаются от субтрактивных процессов. Субтрактивные процессы, такие как фрезерование, токарная обработка или сверление, используют тщательное перемещение инструмента для удаления материала из заготовки для формирования желанной формы продукта. И поэтому в последнее время можно услышать, как кто-то себе сделал бижутерию, брелок для ключей, посуду, аксессуар для дома, чехол для телефона или еще что-нибудь с помощью 3D печати. Несмотря на то что молодое поколение выросло на информационных технологиях, мало кто из них понимает, что благодаря таким технологиям можно напечатать, не только оригинальные аксессуары, но и более масштабные предметы, которые входят в такие отрасли как автомобильная, авиационная и аэрокосмическая промышленности, а также в приборостроение и медицину. В интернете мало можно найти толковую статью, в которой человек может понять аддитивные технологии. Но чтобы разобраться в этой сфере нужно прочитать несколько статей для понимания основ аддитивных технологий. Поэтому в данной статье автор поможет будущим специалистам на начальных этапах обучения разложить знания по полочкам и дать базу, на которую будут класть свои знания. Расскажет историю возникновения аддитивных технологий, как классифицируют производство и где используется эта технология на сегодняшний день.

Ключевые слова: аддитивные технологии, 3D печать, объемная печать.

Additive technologies from the past to today

Additive manufacturing (AM) is the process of manufacturing a product, by adding material in layers in various ways based on a digital model.

The prerequisites for AM were invented at the end of the 19th century. These were volume maps (90s of the XIX century. Joseph Blancher) and a photosculpture (Francois Villiers). Joseph has added melted wax layer by layer so that volumes and cavities on the maps were obtained. And Francois created 3D models of his future sculptures, placing an object in the middle of a circle of 24 cameras, and then taking pictures at the same time. After that, he has projected photos on a piece of granite and has excised the extra material.

And only in the 80s of the last century, Charles Hull invented and patented the world's first 3D printer, which was based on stereolithography technology. At about the same time Scott Crump invented his FDM printer because a printer using stereolithography was expensive.

And only a few years ago (2012), 3D printer for home-use was invented by Hull's company, 3D Systems.

Technology

For today, many-layered technologies have been invented. The hierarchy of 3D printing (Figure 1) is divided by production technology and materials (photopolymer, plastic, powder and polymer).

As can be seen in Figure 1, at first, additive technologies are separated by the printing method, then by technologies, and after that by the properties of the finished product. For example, HP manufactures printers use MJF, technology – melting powders, which is used as a production material, and the finished product is plastic.

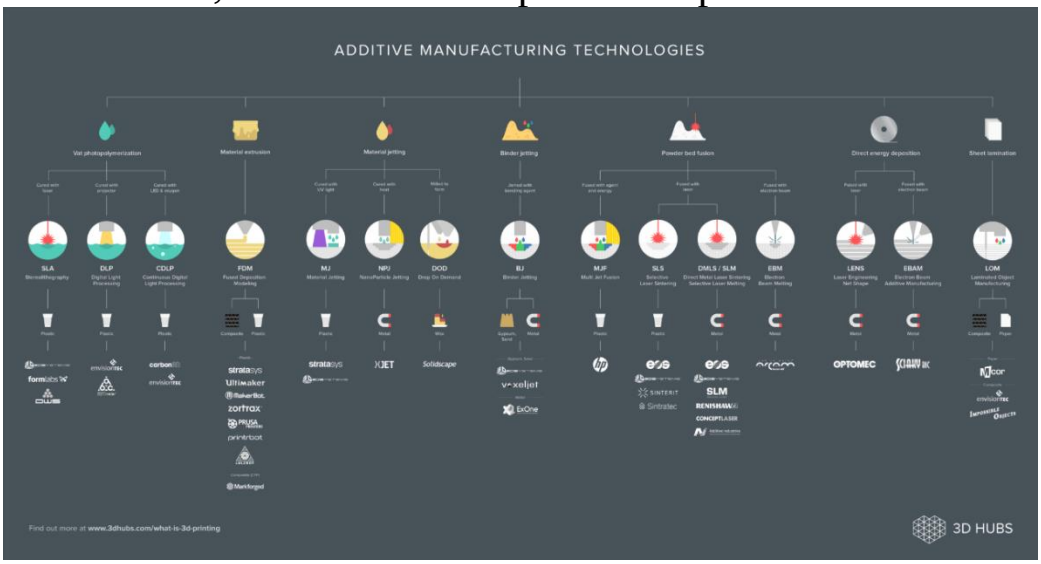

Figure 1 – Additive manufacturing technologies

The use of AM today

Each manufacturer seeks to reduce the products cost, to create reliable and high-quality products. And the use of additive technologies allows you to create such products.

One of the promising areas in additive technologies is the creation of three-dimensional models of metal-powder materials, nickel, cobalt, aluminum and titanium. Molds and original parts of complex configuration, which cannot be obtained by casting or machining, are «grown» from metal powders. A striking example is an operation in 2015 to insert a new titanium hip joint, which was individually manufactured on a 3D printer for the patient.

3D printing is used in construction. To date, unfortunately, only one-story houses can be built. So, in China with the help of additive technologies 10 houses were built for 24 hours. Additive technologies are used in construction for several reasons: it is economically beneficial, environmentally friendly, you can reproduce any geometric shape and the production speed is higher.

Nowadays, confectionery manufacturers are trying to produce products of unusual and attractive shape. To achieve this goal, it is not uncommon for them to resort to layered addition technology. Ordinary sugar cubes are replaced by unusual shapes.

In the aerospace industry, additive technologies are used to test new parts, so as not to spend a large budget on manufacturing parts for traditional manufacturing. But it may happen that the item will not work out efficiently, but the money is spent on it. The American company Boing has more than 22 parts out of 300 produced for 10 types of airplanes using volumetric printing.

Most scientists believe that additive manufacturing (AM) are the future of the manufacturing process. However, they can also find their use in the home use. Therefore, in this article, the technology of layer-by-layer production was considered for a better choice of printer for certain purposes. Also, the history of the AM emergence of this technology for people who are interested in this aspect. And there was shoved also examples where additive technologies are used to select the necessary equipment for a novice employee in an enterprise in order to introduce new technologies.

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